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For: A DEVICE FOR CLOSING A NECK OF A RECEPTACLE, AND A RECEPTACLE PROVIDED WITH SUCH A DEVICE

DECLARATION

I, Andrew Scott Marland, of 11, rue de Florence, 75008 Paris, France, declare that I am well acquainted with the English and French languages and that the attached translation of the French language PCT international application, Serial No. **PCT/FR2004/002922** is a true and faithful translation of that document as filed.

All statements made herein are to my own knowledge true, and all statements made on information and belief are believed to be true; and further, these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any document or any registration resulting therefrom.

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Andrew Scott Marland

A DEVICE FOR CLOSING A NECK OF A RECEPTACLE, AND A RECEPTACLE PROVIDED WITH SUCH A DEVICE

The present invention relates to a device for closing a tubular neck of a receptacle, and to a leaktight receptacle provided with such a device.

More particularly, the invention relates to closure devices comprising both a cap for closing the neck, and a peelable membrane for hermetically covering the lip of said neck in order to guarantee that the receptacle is not put into contact with ambient air between the receptacle being closed, e.g. at the end of a bottling line, and the first occasion on which the receptacle is opened by a consumer of the content of the receptacle, in particular a beverage.

To this end, the membrane generally comprises a layer of aluminum covered on its side adjacent to the neck that is to be closed in a peelable synthetic covering for heat-sealing onto the lip of the neck. To put such a membrane into place, the present practice is to use the cap, by covering the underside of its end wall with the membrane that is to be put into place, and then fitting the cap onto the neck of a receptacle that has just been filled. In order to prevent the membrane from escaping, and in particular in order to prevent it from dropping out of the cap before the cap is placed in register with the neck of a receptacle, the membrane is dimensioned in such a manner that its diameter is slightly greater than the inside diameter of the cap, which means that its diameter is equal to or slightly greater than the outside diameter of the lip of the neck. Once the cap has been fitted onto the neck of the receptacle, e.g. screwed onto the neck, the membrane is interposed between the end wall of the cap and the lip of the neck. The receptacle is then placed close to an induction plate which causes induced currents to appear in the aluminum layer of the membrane, thereby heating it. The synthetic covering melts and is thus heat-sealed

to the lip of the neck. On first use of the receptacle, the consumer unscrews the cap and then removes the membrane by peeling it off.

Although such a device guarantees that the receptacle is sealed on leaving the bottling line, it presents a certain number of drawbacks. Firstly, when the user peels off the membrane, residue of the peelable synthetic material, and possibly also of aluminum, remains on the lip of the neck, which the consumer often sees as lacking in cleanliness or even constituting a health risk. In addition, the sealing of the device when it is reclosed is generally mediocre because of the presence of the residue of peelable synthetic material on the lip of the neck. When the cap is screwed back onto the neck, the residue leaves gaps between the cap and the neck which are harmful to good conservation of the content of the receptacle.

To avoid this drawback, the user of the device is tempted to clamp the cap back on tightly when reclosing the receptacle. However such handling is awkward for the user, and indeed impossible for certain users such as children or old people, and it becomes ineffective in the long run because of the deformation applied to the cap and/or to the neck.

French patent No. 2 828 173 proposes solving that problem by providing for an inner sealing skirt of the cap to bear against an outer zone of the lip of the neck when the receptacle is closed and reclosed, which outer zone is distinct from the inner zone on which a peelable membrane has previously been heat-sealed. Any deposit of adhesive on said inner zone of the lip, and any other damage that stems from heat-sealing the membrane, then does not interfere with the quality of the sealing provided by the inner skirt. However, that sealing is ensured only by the fact that the skirt is designed to be flexible, so that its bears elastically against the outer zone of the lip of the neck. On reclosure, it is

therefore necessary for the user to clamp the cap back on tightly around the neck in order to good sealing, with the drawback mentioned above. In addition, because of its elasticity, the skirt returns to its initial configuration when the cap is removed and thus runs the risk during reclosure of impeding the user by forming an abutment for the neck.

The object of the present invention is to propose a cap and membrane device of the above-described type that guarantees reliable sealing of the receptacle when it is reclosed, while remaining easy both to assemble on the receptacle during initial packaging, and for use by any consumer.

The invention provides a device for closing a tubular neck of a receptacle, in particular a substantially cylindrical neck of a bottle, as defined in claim 1.

In the invention, a distinction is made between firstly the inner zone of the lip that is to enable the peelable membrane to be secured thereto, and secondly the outer zone of the lip against which the skirt of the cap comes to bear, in particular when the receptacle is reclosed. Since no residue of peelable material is present on said outer zone, the skirt can bear thereagainst in perfectly leaktight manner, and since the strength of this bearing force is essentially a function of the co-operation between the skirt in its plastically-deformed configuration and the outer zone of the lip, the user does not need to clamp the cap back on tightly, while reclosing, in order to obtain satisfactory sealing. In addition, in its flared deformed configuration, the sealing skirt does not interfere with putting the cap into place around the neck.

Initial closure of the receptacle, e.g. at the end of a bottling line, is performed in a manner analogous to that used in the prior art, i.e. by placing on the neck

of the receptacle the cap that has been provided internally with the membrane for securing to the neck.

Advantageous characteristics of the device of the invention taken in isolation or in any technically feasible combination are set out in dependent claims 2 to 11.

The invention also provides a leaktight receptacle having a neck for pouring out the content from the receptacle, together with a device for closing the neck, which device is as defined above.

The invention can be better understood on reading the following description given by way of example and made with reference to the drawings, in which:

· Figure 1 is an exploded longitudinal section view of a closure device of the invention, prior to being assembled on a neck of a bottle;

· Figures 2A, 2B, and 2C are views on a larger scale of a detail in circle II in Figure 1, respectively showing three successive steps in assembling the device on the neck of bottle;

· Figures 3A and 3B are views analogous to Figures 2A and 2B relating to a first variant embodiment of the device of the invention; and

· Figure 4 is a fragmentary longitudinal section view of a second variant of the device of the invention.

Figure 1 shows a closure device 1 for closing a leaktight receptacle 2, e.g. for containing a liquid beverage. In Figure 1, only the neck 3 of the receptacle 2 is visible, the receptacle being constituted for example by a bottle of plastics material such as polyethylene terephthalate (PET), of glass, or of any other material that is compatible with storing the liquid under consideration, or more generally that is of food grade. The neck 3 is essentially cylindrical in shape about an axis X-X and is provided on its outside face 4 with a helical thread 5. The free end of the neck 3

forms a rim or lip 6 of rounded shape or at least that is not sharp.

The device 1 essentially comprises a membrane 10 and a cap 20.

For convenience, the description below assumes that the elements of the device 1 that are facing towards the receptacle 2 are facing downwards, i.e. they are directed towards the bottom portions of Figures 1 and 2A to 2C, whereas the elements facing in the opposite direction are considered as being outwardly-directed, i.e. towards the top portions of the same figures.

The membrane 10 comprises an aluminum disk 11 shown in Figure 1 as having the same axis as the neck 3. The bottom face of the disk 11 is entirely covered in a layer 12 of a synthetic material, e.g. of polyethylene, suitable for uniting the membrane 10 hermetically with the lip 6 of the neck 3. More precisely, the layer 12 is suitable for being heat-sealed to the lip 6 when the membrane 10 is subjected to a rise in temperature, in particular by generating induced current in the aluminum disk, while being suitable for being peeled off subsequently by hand. For this purpose, the membrane 10 is advantageously provided on its top face with a layer 13 of plastics material for ensuring that the aluminum disk does not tear while the membrane is being peeled off, and a pull-tab 14 to be taken hold of by the user in order to remove the membrane 10.

In a variant that is not shown, only the outline of the bottom face of the aluminum disk 11 is covered in the peel-off material 12.

In any event, the diameter d_{12} of the peel-off covering 12 is less than the outside diameter D_6 of the lip 6 of the neck 3, while naturally also being greater than the inside diameter d_6 of the lip. In other words, only an inner peripheral zone 61 of the lip 6 is covered by the heat-sealed material 12 of the membrane 10, as is explained in greater detail below. The remainder of the

lip, i.e. the outer peripheral zone distinct from the zone 61 is given reference 62.

The cap 20 is generally cylindrical in shape and is shown in Figure 1 as having the same axis as the neck 3. It is adapted to close the neck in leaktight manner and for this purpose it has an end wall 21 in the form of a solid disk having a main cylindrical skirt 22 projecting downwards from its periphery, the inside diameter of the skirt being substantially equal to the outside diameter of the thread 5 on the neck 3.

The inside face of the main skirt 22 is provided with a projecting thread 23 complementary to the outside thread 5 on the neck 3, the cap 20 thus being suitable for being screwed onto the neck 3 and for being unscrewed therefrom by turning it correspondingly about its longitudinal axis X-X.

Two coaxial inner skirts 24 and 25 centered on the axis X-X are provided inside the cap 20, projecting downwards from the end wall 21. When the cap 20 is not in place on the neck 3, as shown in Figure 1, these inner skirts 24 and 25 extend generally parallel to the main skirt 22.

As shown in greater detail in Figure 2A, the first inner skirt 24 that is radially farther from the axis X-X than the second inner skirt 25 is constituted by a tubular body 241 connected to the end wall 21 of the cap 20 by a root 242 that is a little thicker than the remainder of the body 241. The root 242 presents an essentially cylindrical inside face of diameter referenced d_{242} in Figure 1 that is very slightly smaller than the diameter of the aluminum disk 11 of the membrane 10, i.e., for the membrane shown, the diameter d_{12}. The inside face of the root 242 forms a kind of wedging surface for the membrane 10 while it is being assembled in the cap, as explained in greater detail below. A difference between the diameters of about one-tenth of a millimeter enables such wedging to occur in practice.

The inner skirt 25 is likewise constituted by a tubular body 251 of axial size that is considerably smaller than that of the body 241 of the skirt 24, and corresponds for example to approximately the axial height of the root 242 minus the thickness of the membrane. Its outside face 252, in particular in the bottom portion thereof, flares upwardly towards the end wall 21.

The inside face of the body 241 of the skirt 24 presents two inwardly-bulging, i.e. convex surfaces 243 and 244 in the transition zone between the root 242 and the remainder of the body 241, these two surfaces being disposed one after another along the axis X-X. These bulging surfaces 243 and 244 are separated from each other along the axis X-X by a concave surface 245.

The bottom end portion of the first inner skirt 24 is also provided with a series of projections 246 distributed around the periphery of said skirt and extending radially inwards from the inside face of the skirt. By way of example, this series comprises six projections 246 that are diametrically opposite in pairs. The radial distance referenced d_{246} in Figure 1 between two diametrically-opposite projections is less than the diameter of the aluminum dusk 11 of the membrane 10, i.e., for the membrane 10, less than the diameter d_{12}. In this way, the top faces 247 of the projections 246 constitute safety retaining surfaces for preventing the membrane 10 from dropping out downwards before the membrane is secured to the lip 6 of the neck 3.

Advantageously, the bottom faces 248 of the projections 246 flare downwards for reasons that are explained below.

The way in which the closure device 1 is assembled on the neck 3 of the receptacle 2 is described below with reference to Figures 2A to 2C.

Initially, the neck 3, the membrane 10, and the cap 20 are fabricated independently of one another and they are obtained in the state shown in Figure 1, for example.

In a first step, the membrane 10 is assembled with the cap 20 by inserting the membrane inside the cap. More precisely, as shown in Figure 2A, the membrane 10 is placed inside the first inner skirt 24, e.g. by deforming the membrane elastically, so that its edge becomes wedged against the root 242 of the skirt 24. In this configuration, the cap can be handled in any direction without running the risk of the membrane 10 escaping from the inside of the cap since even if it becomes separated from the root 242, it is retained reliably in a downward direction by the projections 246, in an upward direction by the end wall 21, and in a sideways direction by the body 241 of the skirt 24.

In a variant that is not shown, the membrane 10 is placed inside the skirt 24 without being brought into wedging contact with the root 242. The membrane 10 then rests directly on the projections 246, with the peel-off layer 12 pressing against the top faces 247 of the projections.

In order to close the neck 3 of the receptacle 2 hermetically, e.g. immediately after it has been filled with a perishable liquid, or more generally a foodstuff, the cap 20 carrying the membrane 10 is brought to a position immediately above the neck 3 and on the same axis as the neck. By way of example, this operation can be performed at the end of a bottling line.

Thereafter, the cap 20 is moved towards the neck 3 so as to cause the threads 5 and 23 to engage, with the cap either being forced onto the neck 3 or else being screwed around the neck.

When the end wall 21 of the cap 20 comes close to the lip 6 of the neck 3, the neck splays the skirt 24 radially outwards, with the flared bottom surfaces 248 of the projections 246 then forming ramp surfaces for the lip 6. The body 241 of the skirt 24 then changes from a generally cylindrical configuration as shown in Figure 2A to a generally frustoconical configuration that flares

downwards, as shown in Figure 2B, with the root 242 being deformed, preferably essentially plastically.

As the cap 20 continues to move towards the neck 3, the membrane 10 becomes pinched axially between the inner zone 61 of the lip 6 and the outer face 252 of the skirt 25, as shown in Figure 2B. If the membrane is initially resting on the top faces 247 of the projections 246, then it is brought into contact with the inner skirt 25 by being lifted upwards by the lip 6.

Advantageously, the body 251 of the skirt 25 is provided to be sufficiently flexible to be deformed inwardly, with its flared outside face 252 forming a corresponding ramp surface.

Simultaneously, the bottom face of the skirt 24 comes into contact with the outer zone 62 of the lip 6 which, more precisely, bears against the bulging surfaces 243 and 244.

The receptacle 2 fitted with the cap 20 and the membrane 10 is then subjected to an electromagnetic field that causes electrical currents to be induced in the aluminum disk 11, thereby melting the layer 12, at least in part. On cooling, the layer 12 bonds the remainder of the membrane 10 to the inner zone 61 of the lip 6.

The receptacle is thus closed hermetically and can be transported to its site of sale, or more generally to its place of final use. Compared with prior art devices in which the membrane is of greater diameter in order to enable it to be wedged against the end wall of the cap, the membrane 10 of the device 1 is of smaller diameter and is therefore of lower cost.

When the user of the receptacle 2 seeks to open the receptacle for the first time, the cap 20 is unscrewed to give access to the membrane 10 that is secured to the neck 3. The user takes hold of the tab 14 to separate the membrane by peeling off the layer 12. This peel-off operation can leave residues of peelable material on the inner zone 61 of the lip 6.

No residue remains on the outer zone 62.

After pouring out a fraction of the content from the receptacle 2, the user recloses the receptacle by screwing the cap 20 onto the neck 3 as shown in Figure 2C. By tightening the cap 20 a standard amount, the user can easily bring the top bulging surface 243 of the skirt 24 to bear against the outer zone 62 of the lip 6, as represented by arrow F_1, thereby forming a first line of sealing between the neck 3 and the cap 20. In addition, in a manner that is generally independent of how tightly the user turns the cap, the lower bulging surface 244 is caused to bear against the outer zone 62 of the lip 6, as represented by arrow F_2, thereby forming a second line of sealing.

It should be observed that the bearing force F_2 in the second line of sealing is related essentially to co-operation between the skirt 24 in its flared configuration and the lip 6 of the neck 3. Insofar as the skirt 24 is deformed plastically while the cap 20 is being assembled onto the neck 3 as described above, and during subsequent storage of the bottle in the closed configuration, there is no need for the user to tighten the cap on hard to ensure that the bearing force F_2 transmitted by the skirt 24 against the outer zone 62 of the lip, via the surface 243 is non-negligible. Conversely, it will be understood that the tighter the cap is screwed back on, the greater the bearing force F_1.

In addition, being plastically deformed in the flared configuration, the skirt 24 does not run any risk of forming an abutment for the neck 3, and therefore does not impede the user when screwing the cap 20 back on.

As shown in Figure 2C, the flexibility of the inner skirt 25 is advantageously designed to that when reclosing the bottle, the outer face 252 of this skirt comes to bear against the inner zone 61 of the lip 6, e.g. when a strong tightening force is applied to the cap 20. A third line of sealing is thus formed, but its

quality nevertheless remains limited because of the possible presence of residue of the peelable material 12 in said zone of the lip 6.

Two variants of the device 1 are shown respectively in Figures 3A and 3B and in Figure 4. In these variants, elements that are common with the device of Figures 1 and 2A to 2C are given the same references.

In the variant of Figures 3A and 3B, the inner skirt 24, instead of having the top bulging surface 243, is provided with an annular bed 249 projecting radially from the inside face of the skirt. The bottom face of this bead presents a surface 243' that acts in a manner analogous to the surface 243. More precisely, the surface 243' is adapted to transmit the bearing force F_1 associated with the clamping torque applied to the cap 20 when the user recloses the receptacle 2.

This variant of Figures 3A and 3B also differs from the device of the preceding Figures in the profile of the outside face 252 of the second inner skirt 25. The bottom portion 253 of this face is shaped in a manner that is substantially complementary to the inner zone 61 of the lip 6 in such a manner that firstly when the cap 20 is initially assembled on the neck 3 the membrane 10 is pressed in uniform manner against the zone 61, and secondly, when the membrane is peeled off and the cap is screwed back on, a large bearing area is formed between the skirt 25 and the zone 61.

In the variant of Figure 4, the bottom face of the end 21 of the cap 20 is provided in its center with a projecting disk 26 on the axis X-X made integrally with said end wall. The axial dimension x_{26} of the disk relative to the bottom face of the end wall is substantially equal to the axial dimension of the skirt 25 in its non-deformed state. The bottom face of the disk is covered in a slightly sticky substance 261 for facilitating assembly of the membrane 10 in the cap 20. When the membrane is inserted into the skirt 24, it is

then taken upwards until its top face comes into contact with the sticky substance 261 which then serves to hold the membrane to the end wall of the cap until the cap is assembled on the neck 3. Once the membrane 10 has been heat-sealed, there is no longer any need for the adhesive bond between the membrane 6 and the central disk 26 of the cap to be maintained. In addition, when the cap 20 is unscrewed for the first time, this adhesive bond is very easily broken, since the strength of the peelable heat-sealed connection between the membrane and the lip is much greater.

This variant makes it possible to omit accurately controlling the relative dimensions of the membrane diameter and the inside diameter d_{242} of the root 242 of the skirt 24 since the root no longer acts alone to hold the membrane 10 against the end wall of the cap. In addition, the adhesive layer 261 serves to hold the membrane in a manner that is more stable than being wedged by the root 242, in particular to hold it in a manner that is less sensitive to vibration and to the jets of compressed air that might be used to drive the caps along a bottling line.

Various improvements and variations to the above-described devices can be envisaged. For example, the projections 246 could be replaced by a flexible lip extending continuously around the entire periphery of the inside face of the skirt 24, in particular in the form of an olive-type lip. Similarly, the pull-tab 14 of the membrane 10 can be replaced by a pull-fringe made integrally out of the same material as the top layer 13 over a fraction of its peripheral outline and suitable for being folded down onto the top face of said layer when the membrane is assembled into the cap.